National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Invasive Plant Management in Kenai Fjords National Park

2011 Summary Report

Natural Resource Data Series NPS/KEFJ/NRDS—2011/223

ON THE COVER
Clockwise from top left: Kenai Fjords EPMT and SAGA crews controlling along Exit Glacier Road; herbicide operations in the Exit Creek Outwash Plain; SAGA crew volunteering for the Community Weed Pull event; EPMT crew crossing Exit Creek to access the Outwash Plain.
Photographs by: Kenai Fjords National Park staff

Invasive Plant Management in Kenai Fjords National Park

2011 Summary Report

Natural Resource Report NPS/KEFJ/NRDS—2011/223

Travis Fulton

National Park Service
Kenai Fjords National Park
500 Adams Suite 103 / PO Box 1727
Seward, AK 99664

December 2011

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from Alaska Region Exotic Plant Management Team Reports website (http://www.nps.gov/akso/NatRes/EPMT/reports.html) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

Please cite this publication as:

Fulton, T. 2011. Invasive plant management in Kenai Fjords National Park: 2011 Summary report. Natural Resource Data Series NPS/KEFJ/NRDS—2011/223. National Park Service, Fort Collins, Colorado.

NPS 186/111999, December 2011

Contents

Contents (continued)

Figures

Tables

Abstract

This report describes the work performed by the Alaska Exotic Plant Management Team in Kenai Fjords National Park during the 2011 field season. This is the eighth season that Kenai Fjords National Park has monitored and controlled for invasive plants following the management protocol established by the Alaska Exotic Plant Management Team. The 2011 Kenai Fjords' Exotic Plant Management team included one Biological Science Technician, one Student Conservation Association intern, and two Youth Conservation Corps crew members. Volunteers, community groups, and partner organizations also helped with invasive plant control efforts. As with previous seasons monitoring and control work was focused in the Exit Glacier area and along the Exit Glacier road. A number of other locations were surveyed or controlled in 2011 including sites in Nuka Bay, McCarty Fjord, Northwestern Fjord, and Aialik Bay. Control work was mostly performed manually, although herbicide was used for the first time at Kenai Fjord National Park in 2011 to treat an infestation of common dandelion (*Taraxacum officinale* spp. *officinale*). Invasive plant infestations were mapped using a Trimble GeoXT GPS. Data was edited and analyzed using GPS Pathfinder Office and ArcGIS. The Kenai Fjords Exotic Plant Management Team surveyed 27.6 acres of park lands and 9.3 acres outside park boundaries for invasive species. A total of 8.3 acres of invasive plant infestations were mapped. The team treated 6.9 acres of invasive plant infestations, 3.1 of these acres were controlled with herbicide. Over 1,780 pounds of invasive plants were manually pulled and removed from the park. This season a number of new small infestations were discovered on the outskirts of known infestations, and one new population was discovered at Pedersen Beach in Aialik Bay. Monitoring and control efforts should continue at Kenai Fjords National Park to prevent the further spread or introduction of invasive plants within the park and to keep native ecosystems intact. For the first time in 2011, Alaska Exotic Plant Management Team staff conducted monitoring for invasive European and Asian Gypsy Moths (*Lymantria dispar* and *L. dispar japonica*). Traps were set at Exit Glacier due to the sites vulnerability to invasive introductions. After repeated checks throughout the season the traps were found to be free of Gypsy Moths. Monitoring for these species should continue as they pose a significant threat to the native vegetation of the area.

Acknowledgments

The 2011 Kenai Fjords Exotic Plant Management Team would like to thank all the volunteers, community groups, park employees, and visitors who helped make the 2011 field season a success. A special thanks to the Kenai Fjords Exotic Plant Management Team members: Student Conservation Association interns Becky Thompson and Tina Robinson, Raine Becker and Jeremy Bunch of the Youth Conservation Corps, and to Bonnie Million and Tim Federal of the regional Alaska Exotic Plant Management Team. We would also like to thank the Southeast Alaska Guidance Association crews, the Resurrection Bay Conservation Alliance, USS Lake Erie volunteers, and all Kenai Fjords employees that helped during the Community Weed Pull. Your efforts are greatly appreciated. And, finally, thanks to former Kenai Fjords Exotic Plant Management Team crew leaders Christina Kriedeman and Deborah Kurtz whose readily shared knowledge and experience was invaluable to the 2011 crew in our efforts. Many of the maps in this report are directly attributable to Deborah Kurtz's 2010 Invasive plant management report for Kenai Fjords National Park and are updated where necessary for 2011.

Abbreviations

ADA	American Disabilities Act
AKNHP	Alaska's Natural Heritage Program
EPMT	Exotic Plant Management Team
GPS	Global Positioning System
HIT	Harding Icefield Trail
IPMP	Invasive Plant Management Plan
KEFJ	Kenai Fjords National Park
NPS	National Park Service
PUC	Public Use Cabin
RBCA	Resurrection Bay Conservation Alliance
SAGA	Southeast Alaska Guidance Association
SCA	Student Conservation Association
USFS	United States Forest Service

Introduction

Kenai Fjords National Park (KEFJ), at over 1500 square miles, is dominated by the massive Harding Icefield and the many glaciers flowing off of it. Over 500 square miles of park land is covered in glacier, and much of the rest of the park can be classified as early-succession, post-glacial environment. These recently disturbed landscapes are highly susceptible to invasion by a number of non-native, invasive plant species which can out compete native species and have a negative impact on natural ecosystem diversity and processes.

With a landscape so young and relatively pristine, KEFJ is in a unique position to be able to effectively control the intrusion of invasive plant species before they become established on park lands and to avoid the difficulties that riddle compromised ecosystems in many other parts of the United States and the world. The National Park Service (NPS) Exotic Plant Management Team (EPMT) program offers a systematic approach to invasive plant management, focused on the principles of 1) prevention, 2) inventory and monitoring, 3) treatment and control, 4) early detection and rapid response, and 5) restoration. By preventing the spread of invasive seed and propagules into the park, catching invasions before they become established, and dealing with them in early stages of population growth, KEFJ can maintain ecological integrity and allow plant succession to proceed unimpaired.

Much of the land in KEFJ that is not buried beneath the Harding Icefield is fjord land located on the southern coast of Alaska's Kenai Peninsula and opens into the Gulf of Alaska. Most people that visit these fjords do so in tour boats and never even step foot onto land. The vector to introduce invasive seeds into this area is, therefore, very small. The Exit Glacier area in the northeast corner of the park is easily accessible by road and has the most visitor use. According to KEFJ traffic counters, 114,723 people visited the Exit Glacier area between May 10, and August 31 of 2011 (C Kriedeman, personal communication, September 15, 2011). The eight mile access road crosses private, State of Alaska, and US Forest Service (USFS) managed lands before it enters KEFJ. This road is lined with several invasive plant species and provides a ready vector for their introduction into the park.

The KEFJ EPMT team implements a strategy where park lands along this foremost vector are regularly monitored for invasive species. Disturbed areas within the park, such as old mining sites or popular visitation spots, are usually monitored at least once per season. Outlying infestations both on and off the trail system or at rarely visited fjords receive swift control efforts to keep these plants from becoming established in natural, and hard to reach areas. The Exit Glacier road system with its easy accessibility and well established infestations of some common invasive species requires intensive treatment to control. Treating large front-country infestations is a lower priority than smaller backcountry infestations that are located in less developed, harder to reach areas. By controlling these smaller infestations in the backcountry it is hoped that invasive plant invasion can be kept under control and limit the spread to other areas of the park.

Gypsy Moth monitoring began in the Exit Glacier area in 2011. This project complements the invasive plant control work of EPMT and a project summary is included in Appendix B of this document.

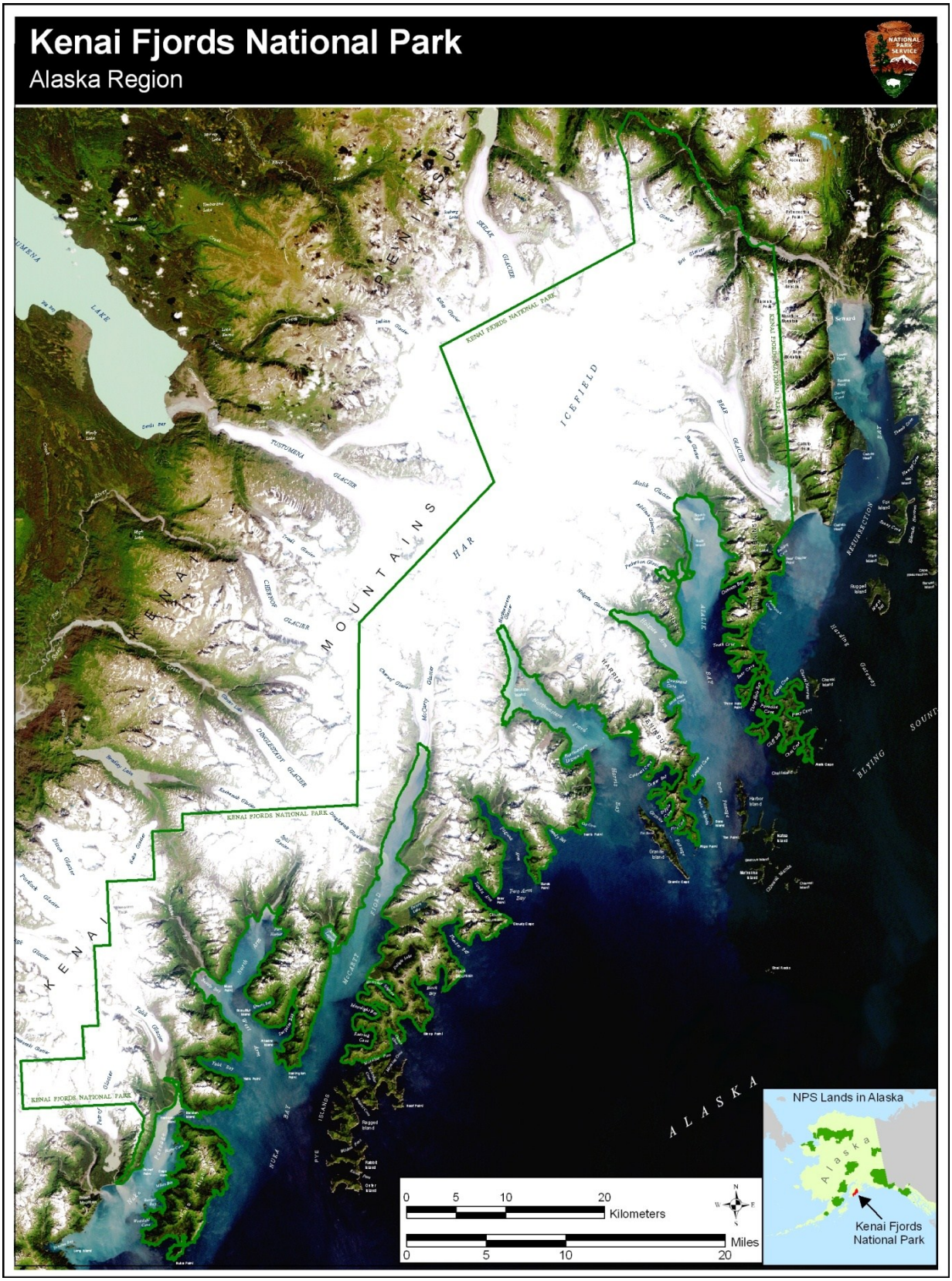

Figure 1. Location map of Kenai Fjords National Park.

Methods

The Alaska EPMT program has been operating in KEFJ since 2003. The KEFJ EPMT follows the invasive plant management strategy described in the Alaska EPMT 2011 Field Protocol (Million and Rapp 2011). The ultimate goal of this approach is to prevent the introduction of invasive plants, to inventory and monitor invasive infestations, and to work on control and eventual eradication of established infestations of non-native, invasive plants in the park.

Surveying and mapping is done with a Trimble GeoExplorer 2008 series GeoXT global positioning system (GPS), as well as with a 2005 GeoXT model. Historical data collected by park staff in previous years is loaded onto the units and assists field teams in returning to surveyed infestations for treatment. All infestations are mapped and historic infestations are revisited and inventoried for the presence or absence of invasive plants. Additionally, each year new sites are selected for survey due to their proximity to existing invasive plant infestations or their susceptibility to infestation. Field collected data is post processed and edited by KEFJ staff using GPS Pathfinder Office software. The edited data is then uploaded to the regional Alaska EPMT office where the information can be compiled.

Prior to 2011 all plant removal efforts involved manual treatments utilizing hand-pulling with the use of shovels and diggers. This season marked the first year that chemical control methods were used in KEFJ. An infestation of common dandelion (*Taraxacum officinale* spp. *officinale*) established in a remote off-trail location in the Exit Glacier area was treated with herbicide. It is hoped that chemical control can adequately reduce this infestation using fewer labor hours, park resources, and with minimal negative impacts on the environment.

The 2011 KEFJ EPMT field season lasted from mid-May through the end of September with a number of core staff serving shorter seasons within that timeframe. Work was led and organized by a Biological Science Technician and was assisted by a Student Conservation Association (SCA) intern, two Youth Conservation Corps interns, as well as two AmeriCorps crews from the Southeast Alaska Guidance Association (SAGA). Alaska EPMT regional staff led the herbicide treatment operations within the park assisted by KEFJ EPMT personnel. The 2011 KEFJ EPMT also included a new position, a SCA intern which focused exclusively on Invasive Plants Education & Outreach. A number of other members of KEFJ staff helped during a volunteer event and as needed based upon their availability and experiential knowledge.

Distribution of Invasive Plants

Invasive plant infestations in KEFJ are concentrated in the areas of highest use, with the Exit Glacier area containing the most extensive infestations in the park. The 2011 KEFJ EPMT efforts were focused on containment of Exit Glacier invasive plant infestations and the complete removal of smaller infestations found elsewhere in the park. Monitoring and inventory sites in 2011 were associated with previously known infestations in the Exit Glacier area and on new survey sites on the outer coast most likely to have visitor use.

Exit Glacier Area

By far the greatest diversity and numbers of invasive plants are found in the heavily used areas around Exit Glacier. The road system outside of the park boundary leading into KEFJ is infested with significant populations of non-native plant species and provides a ready vector for

introduction of these plants into the park. As a result, the Exit Glacier road system and parking areas show the heaviest invasive plant infestations within the park. Control efforts by KEFJ EPMT focused on the most heavily used parts of the road system, and areas where people commonly stop and get out of their cars. It is hoped that by keeping these areas relatively invasive plant free that new seed introductions can be dealt with swiftly and effectively and that seed spread into more pristine areas of the park can be lessened.

KEFJ EPMT efforts began at the start of June 2011 in the Exit Glacier parking lot while common dandelion plants were still small and had not yet flowered or gone to seed. This area was revisited on multiple occasions throughout the season to control any missed dandelions or other invasive species as they began germinate. A final, late-season survey of the parking lot was conducted to remove any invasive plants that were missed before the onset of winter.

Areas of the road were selected for manual control in 2011 due to their likelihood as invasive seed spread vectors. One SAGA youth crew as well as one volunteer school group assisted KEFJ EPMT members with common dandelion control at the parking lot entrance, the campground parking area, the 1889 moraine, and at the pull-out at with the park's entrance sign.

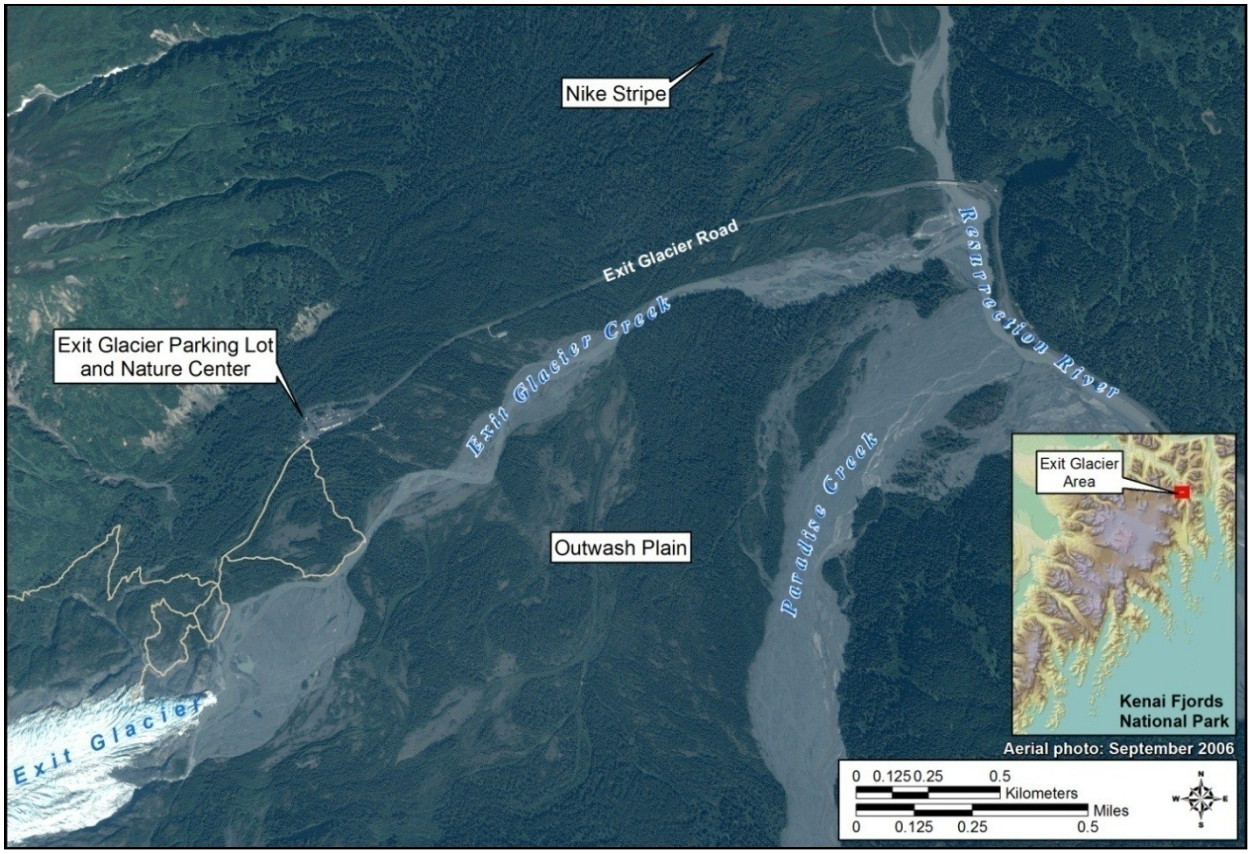

Figure 2. Locations of invasive plants in the Exit Glacier area.

Two large and isolated backcountry populations of common dandelions at the Outwash Plain (south of Exit Glacier Road) and the Nike Stripe" (north of Exit Glacier road) were visited in June 2011. It is necessary to visit these infestations early in the season before high water conditions of summer make access difficult and potentially hazardous. Both sites were selected

to receive herbicide treatment in 2011; however, the "Nike Stripe" was only manually treated due to time and weather constraints.

Outer Coast

There were three KAFJ EPMT trips to the outer fjords of KEFJ in 2011. Two trips were to high visitor-use areas of Aialik Bay and the third trip to the far southwest coast of the park via the park's research vessel, the M/V Serac.

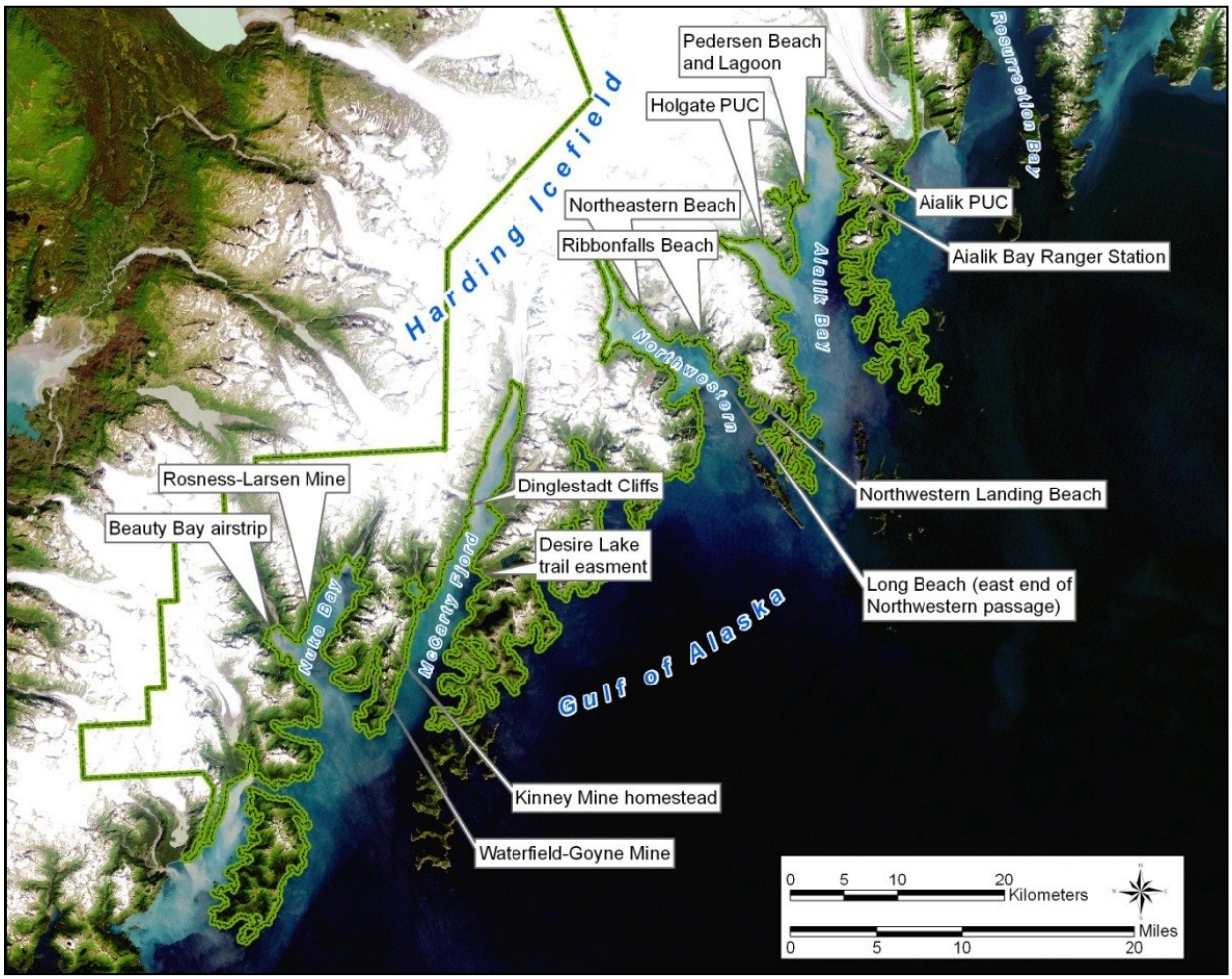

Figure 3. Outer coast sites visited by KEFJ EPMT in 2011.

Known infestations of non-native annual bluegrass were controlled twice around the Public Use Cabins (PUC) in Aialik Bay once in early July and again in September. Surveying efforts were conducted along Pedersen Beach and lagoon at the KEFJ camping easement, and on the new trail accessing the upper Pedersen lagoon from Kenai Fjords Wilderness Lodge. A new notable infestation containing pineapple weed, common plantain, and annual bluegrass was discovered on Pedersen Beach near the lodge's kayak storage area.

A five-day trip was conducted in late July to a number of outer coast fjords via the M/V Serac. Six EPMT members controlled a known infestation of common timothy (*Phleum pretense*) at the Beauty Bay airstrip, and an infestation of common dandelions growing on cliffs above the toe of

Dinglestadt Glacier. An unknown plant, first discovered in 2010 and believed to be a non-native *Prunella* species, was revisited with the intent to collect the specimen for identification. During the July trip, however, the plants were not in flower so the crew decided to return at a later date. The plants' position was mapped the crew returned to the site in late August and collected a more mature specimen. Two mine sites within in Nuka Bay, one trail easement in McCarty Fjord, and four camping beaches within Northwestern Fjord were surveyed and found to be free of non-native plant species.

Results

Overview

KEFJ EPMT efforts in 2011 were focused on revisiting all previously surveyed non-native plant infestations, as well as on the thorough control of as many of these infestations as possible. New infestations of invasive plants, all associated with previously known populations, were found, mapped, and treated in the Exit Glacier area at the Outwash Plain and the Nike Stripe, and on the outer KEFJ coast at Dinglestadt Glacier. Total species acres surveyed decreased in 2011 compared to 2010, while the species acres infested and acres treated by KEFJ EPMT staff increased significantly (Table 1). In 2010 a considerable effort was put toward initial site surveys in areas not known to contain invasive plants, such as sites on the outer coast and on the Exit Glacier outwash plain, and found to contain none. In 2011, however, a much greater emphasis was put on fully mapping historically known populations to find their latest extents. These differences in survey efforts explain why in 2011 significantly less total area was surveyed while total infested area surveyed increased dramatically. Much of the increase in treated area in 2011 over previous years is attributable to over 3 acres treated in the herbicide operations on a dandelion population that had previously only been minimally controlled using manual methods.

Table 1. Summary of Kenai Fjords National Park Invasive Plant Management.

Year	Invasive GPS Data NPS Lands (non-NPS lands)		
	Species Acres Surveyed	Species Acres Infested*	Acres Treated
2004	2.8 (0.5)	1.7 (0.5)	0.5 (0.5)
2005	9.7 (0.1)	2.8 (0.01)	2.3 (0.01)
2006	42.7 (0.3)	5.4 (0.3)	4.8 (0.2)
2007	23.5 (1.8)	5.2 (0.01)	1.9 (0.01)
2008	24.0 (0.2)	3.4 (0)	1.7 (0)
2009	26.1 (3.2)	2.7 (0.01)	2.3 (0.01)
2010	55.9 (5.9)	5.5 (0.01)	3.4 (0.01)
2011	27.6 (9.3)	7.5 (0.8)	6.1 (0.8)

* Acres infested are calculated by acres mapped times the percent cover in areas greater than 0.5 acres. If under 0.5 acres, acreage mapped is counted as 100%.

Exit Glacier Area

Exit Glacier Road

Exit Glacier road crosses a number of land-use jurisdictions, including private holdings, state of Alaska, and USFS land, over its eight mile length. The road connects the Seward Highway near the town of Seward, to the end of the road at the Exit Glacier parking lot within KEFJ. Outside park boundaries the road supports a number of highly invasive plant species including fall dandelion (*Leontodon autumnalis*), narrowleaf hawksbeard (*Crepis tectorum*), yellow alfalfa (*Medicago sativa*), white sweetclover (*Melilotus albus*), bird vetch (*Vicia cracca*) and oxeye daisy (*Leucanthemum vulgare*), as well as the locally ubiquitous common dandelion. The final

1.5 miles of the road are within park boundaries, and like the rest of Exit Glacier road, is heavily infested over most of its length with common dandelion. All other non-native species found along the KEFJ section of the road receive high-priority and swift control because infestations are still small and easily manageable.

The gravel fill that lines Exit Glacier road provides ideal habitat for many invasive species as well as early succession native species such as alder (*Alnus spp.*), willow (*Salix spp.*), and fireweed (*Chamaenerion angustifolium*). In 2011 the KEFJ EPMT continued with the strategy developed in previous years to focus control efforts in the most highly used areas along the road system. Intersections and pull-outs, where visitors are most likely to come in contact with and to introduce seed, were intensely controlled for all non-native species. 95 to 100 % of all invasive plants, including common dandelions, were removed from these areas.

The entire Exit Glacier trail system was mapped and inventoried several times over the course of the 2011 field season, with small infestations of common dandelion, common plantain (*Plantago major*), and pineapple weed (*Matricaria discoidea*).Mouse-ear chickweed (*Cerastium fontanum*) was found sporadically throughout the area. Larger infestations of annual bluegrass (*Poa annua*) were controlled near the Nature Center and along the Main Trail. Isolated non-native plants were mapped and pulledas seen throughout the season.

Figure 4. SAGA crew controlling common dandelion along Exit Glacier Road.

Common dandelion control occurred near the beginning of the field season, before the plants had fully flowered and gone to seed. With the help of a AmeriCorps SAGA crew, for five days in June, dandelion was controlled from the park boundary at the Resurrection River Bridge to the entrance sign pullout, at the 1889 moraine, and at the intersections with the public campground and the employee housing areas. These areas were determined to experience the greatest number of visitors stopping their vehicles, getting out of their cars, and potentially picking up non-native seed (or leaving them in the relatively invasive plant free areas of housing and the campground). Additionally, dandelion flower heads were pulled from the Exit Glacier parking lot to the campground entrance in an effort to decrease the number of seeds being dispersed near these high-use areas with very few non-native plants.

The efforts of the KEFJ EPMT crew along the Exit Glacier Road were primarily focused on keeping all other invasive plant species from becoming established (and removing existing species) using the technique of early detection and rapid response. The entire road within KEFJ boundaries was foot surveyed, once in early season and again near the end of the field season. Common plantain, white clover (*Trifolium repens*), common timothy, yellow toadflax (*Linaria vulgaris*), and pineapple weed were found and controlled at a rate of 95-100%.

In late July,early August, and again in September a portion of Exit Glacier Road within the park experienced seasonal flooding for the third consecutive year. Water flowing over the road just

west of the Resurrection River Bridge forced the closure of the road into the Exit Glacier area on August 3 and 4, and September 7 and 8, 2011. This section of road has been reinforced annually with fill material and is watched closely for emergence of any new invasive plants. The flooding seems to have removed much of the fill which lines most of the road and this area is notably devoid of plants of any kind. Areas where fill along the road did not wash out still harbor infestations of yellow toadflax, common timothy, and common dandelion. Interestingly, white clover seems to tolerate periodic flooding more readily than most species and continues to persist on the flood-scoured roadside though in easily controlled numbers. Through a combination of focused effort by the KEFJ EPMT staff and by the scouring action of flooding events, the only yellow toadflax population within the park has been drastically reduced. Annual control has reduced this infestation from an extensive and continuous population stretching nearly ¼ mile along the roadside in 2004 to a few sporadic remnant patches totaling less than one square meter in 2011.

Brushing operations conducted by the KEFJ maintenance staff in early August 2011 cut down known patches of common timothy and made them impossible to relocate by KEFJ EPMT staff. A concerted effort to complete EPMT work along the roadside before brushing operations, or to better coordinate EPMT efforts with park maintenance, should be effective in eliminating lapses in control of known species along Exit Glacier road.

Exit Glacier Parking Lot

The Exit Glacier parking lot area represents an important buffer between the severely infested road system and the relatively invasive plant free park trail system. Maintaining this area has continued to be a high priority for the KEFJ EPMT. Control efforts in the parking lot area began in early June and continued throughout the summer. Efforts were successful in controlling 95-100% of common dandelions, the most widespread invasive species here, as well as common plantain, white clover, and pineapple weed. The infestation of sheep sorrel (*Rumex acetosella*) on the north side of the parking area, which was not detected in 2010, was found again, mapped, and treated in 2011. Sheep sorrel, by its ability to regrow from small pieces of roots or rhizomes left in the soil, can persist in a greatly reduced form from year to year. Control efforts in 2009 may have so reduced the plants that little above ground growth appeared in 2010, and with two seasons to reestablish its system of roots and rhizomes, may have been able to once again grow and flower in 2011. Only by removing as much plant material as possible, especially the spreading rhizomes, is it possible to effectively reduce the extents of sheep sorrel infestations.

In 2011 a new handicapped accessible picnic area was installed on the southwest side of the RV parking strip. Construction efforts and gravel fill may be vectors for invasive plants to become established. While no invasive plants were found here in 2011, this area should be monitored thoroughly in upcoming years.

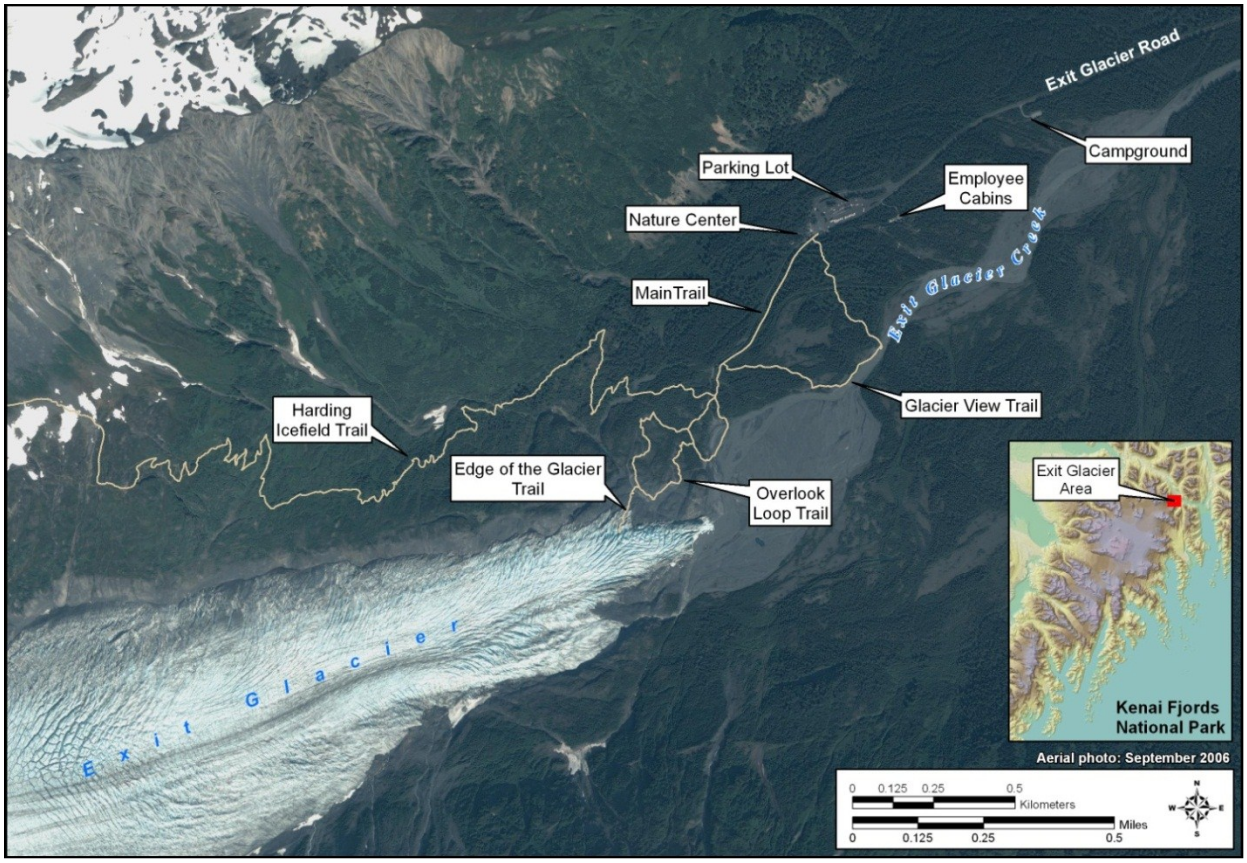

Figure 5. Developed sites in the Exit Glacier area.

Campground

The Exit Glacier public campground is composed of 12 walk-in campsites, food storage and cooking shelter, restrooms, and a parking area. Scattered plants of common dandelion and plantain were found and controlled around the parking lot and restrooms, with larger patches of annual bluegrass controlled on the west end of the parking area. The campsites and food shelter were found to be notably free of invasive species. An ADA accessible path was built between the restrooms, the food shelter, and two campsites in 2011. Construction involved the use of imported fill and heavy equipment. This project area should be monitored in the future to be sure that it was not contaminated with invasive seeds.

Employee Cabins

Very few invasive species were found growing around the cabins and the trail builders' camp, and no new infestations were observed here. A single curly dock (*Rumex crispus*) plant in front of Willow cabin, a small patch of common dandelions behind Cottonwood cabin, and sporadic dandelions, plantain, and pineapple weed in front of Alder cabin were all fully controlled. In 2011 a new SNOTEL climate station was installed behind Cottonwood and Willow cabins, and was accessed via a rough path cut behind Cottonwood cabin. It is recommended that KEFJ EPMT returns to this site in the future and confirms that no invasive species were introduced.

Main Trail

The Main Trail was monitored on a regular basis throughout the 2011 field season. Common dandelion, plantain, pineapple weed, and mouse-ear chickweed occur sporadically along the trail although infestations are especially concentrated near the trail entrance at the Nature Center. Infestations were mapped and controlled when observed. This marked the second year that annual bluegrass was controlled along this trail, this late season effort was assisted by a four person SAGA crew.

Figure 6. KEFJ EPMT crew monitoring the Main Trail of Exit Glacier.

The infestation of annual bluegrass on the Exit Glacier trail system and the lower Harding Icefield trail grew very sparsely prior to 2009, when they were noted in greater abundance around the Nature Center and along the Main Trail (Kurtz 2010). Mapping and control efforts for annual bluegrass began in 2010 and were repeated again this year. Though the infestation was thoroughly controlled in 2010, the population was still dense through most areas in 2011. It is hoped that a yearly 100% control effort of the annual bluegrass infestation along the lower trails will lead to a reduced population density which will be manageable for the KEFJ EPMT crew to maintain.

Glacier View Trail

A small infestation of common dandelion exists on the 1917 moraine, and was thoroughly controlled again in 2011. This site should continue to receive attention as it is easily overlooked. Dandelions here get robust, are obscured by other vegetation, and grow back into the forest on the moraine. Additionally, along an abandoned section of trail between the viewpoint on the Glacier View Trail and the Outwash Plain access trail, KEFJ EPMT controlled a small remnant infestation of common dandelion and common plantain. These small outlying infestations should be a high priority for subsequent treatment in order to avoid the reestablishment of this species in rarely visited areas.

Edge of the Glacier Trail

A small patch of common dandelions and a small but significant infestation of annual bluegrass were controlled at the edge of the Glacier Trail in 2011. These infestations are closer to areas that have been recently disturbed by Exit Glacier than any other infestations of invasive plants on the lower trails. The patch of dandelions, obscured in vegetation on the short switchbacks on the north side of the loop, has been monitored since it was first noticed in 2008. All of the invasive plants were pulled during each site visit. It appears that this infestation is decreasing in density and will be eradicated if persistent control efforts continue. It is important to monitor and control this infestation to prevent seeds from spreading up the newly exposed terrain.

The annual bluegrass infestation at the edge of the Glacier Trail was first controlled in 2011. This infestation occurs in a recently deglaciated area, in moist pockets of soil near the top of the loop trail. Annual bluegrass often functions as a dominant pioneer species able to limit other colonizing plants by reducing seed germination and survival (Bergelson 1990). It is important to keep this area free of invasive plants so that early-phase plant succession can occur unimpeded by competition with non-native species.

Harding Icefield Trail

The Harding Icefield Trail (HIT)is a four mile trail that gains approximately 3,000 feet of elevation. Although it receives far less use than the lower Exit Glacier trail system, it is a very popular and well used backcountry trail. The KEFJ EPMT crew surveyed this trail weekly for invasive plants. Common dandelion and common plantain are found sporadically along the first mile of trail. One larger infestation of common dandelion persists on an old section of trail that closed after 2008. This population has been controlled every year by the KEFJ EPMT staff and has shown a marked reduction in size and density.

Figure 7. KEFJ EPMT staff mapping annual bluegrass on the Harding Icefield Trail.

Prior to 2011 annual bluegrass was observed slowly moving onto the HIT eventually forming dense patches in the first mile of trail (Kurtz 2009). Annual bluegrass is capable of spreading into areas kept open by trampling and therefore thrives on area trails effectively crowding out the establishment of native vegetation (Hutchinson and Seymour 1982). Annual bluegrass was controlled on the HIT for the first time in 2010 with 95 to 100% of plants removed (Kurtz 2010). In 2011 infestations of bluegrass were once again observed growing along the first third of the HIT sporadically in some places and in dense mats in others. Fortunately they had not spread up the trail or moved into new areas. Control efforts were repeated this year with the assistance of a four person SAGA crew for three days in early August, with the majority of the annual bluegrass removed from the HIT. The infestations appear to have reduced slightly from 2010, but substantial quantities were removed again in 2011. Annual bluegrass infestations will continue to be significant until the seed bank in the soil is gone. Continued effort should be made to control annual bluegrass along the lower HIT and to keep it from moving further up trail. With diligent efforts this infestation could be reduced and made more manageable.

Nike Stripe

An invasive plant survey in 2002 discovered an infestation of common dandelions growing in an off-trail location north of Exit Glacier road (Bryden 2002). Due to the shape of the infestations on satellite imagery, this area is referred to as the “Nike Stripe” by KEFJ EPMT crews. The Nike Stripe has been monitored and controlled since 2002. KEFJ EPMT mapping efforts in June 2011indicated a reduction in the overall density of the infestation but a reduction to the size. Due to the remote nature of this infestation and the possibility to introduce other invasive species as manual efforts continue, this area was chosen as a candidate for herbicide application under the

Alaska Region Invasive Plant Management Plan (IPMP). Time and weather constraints did not allow Alaska EPMT staff to conduct herbicide operations here in 2011; therefore it was manually controlled this year. The infestation area is approximately .79 acres and has been proposed to receive chemical treatment in late May or early June in 2012.

Outwash Plain

An isolated infestation of common dandelion was initially reported growing on the south side of Exit Creek in 2002 (Bryden 2002). It was not until 2006 that KEFJ EPMT members conducted a more complete inventory and the first control efforts on these plants (Wetherbee 2006). Monitoring and control efforts have been repeated annually since 2007, with each year's crew discovering new, larger extents to the infestation. In 2010 priority efforts were given to fully mapping the outwash plain, and it was believed that the full extents of the infestation had been documented (Kurtz 2010). Using the criteria identified in the Alaska Region IPMP, this area was chosen to receive chemical control methods in 2011.

On June 9-10th and June 16-17th the Alaska Regional EPMT joined the KEFJ EPMT to map and chemically control the common dandelion infestation on the outwash plain. Crew members crossed Exit Creek in low water conditions and used legacy data to locate and control plants at the furthest known extents. The crew focused efforts on eliminating outlying groups of plants. By controlling the infestation starting from the boundaries and working in toward the core the EPMT hopes to reduce the infestation into a manageable population. Time and weather constraints did not allow control of the entire infestation, but the treatment of 3.1 acres is significant and much more than has ever been treated using manual control efforts.

Figure 8. Spot spraying of common dandelion on the outwash plain.

The two members of the regional EPMT team, both certified Pesticide Applicators in Alaska, applied the herbicide Milestone VM, at a rate of 4 ounces per acre of active ingredient. By using backpack sprayers and spot control methods, any overspray or non-target application was minimized. A small number of new patches of dandelions were mapped and controlled, but the area of the entire infestation did not significantly increase.

The outwash plain will remain a high priority for mapping and control efforts because it is an isolated infestation with high potential for further spread into more backcountry locations. Accessing the outwash plain will always be a logistical issue as the height of Exit Creek makes it unsafe to cross during high snow-melt conditions in early summer or during periods of high precipitation.

Herbicide application is limited by rainy weather conditions, as the spray needs a six-hour dry period to fully soak into treated plants. Chemical control efforts on the outwash plain is the only method, short of establishing a spike camp and devoting large crews to the project, which can

feasibly deal with an infestation this large. The site will be monitoring in 2012 to evaluate the effectiveness of the herbicide treatment.

Maintenance Yard

The KEFJ maintenance yard is located outside park boundaries in a residential area infested with many invasive plant species. Regular monitoring and control of this area by KEFJ EPMT staff prevents the establishment of any invasive plant infestations, which could then easily spread seeds by vehicles and equipment into the park.

Common dandelion and plantain have been controlled in the maintenance yard since 2007 (Wetherbee 2007). Since 2008 control efforts in the maintenance yard have become a high priority, and, with help of volunteer crews, the infestations have become noticeably sparser (Kurtz 2010). In 2011 this area was manually controlled for three days by the KEFJ EPMT. Common dandelion, common plantain, annual bluegrass, and pineapple weed were all pulled at the infestation site.

Coastal Areas

Due to the difficulty of access and the notably small amount of invasive plant infestation, EPMT efforts on the outer coast of KEFJ vary annually. The few sites known to contain invasive plants receive the highest priority for monitoring and control. Initial site surveys for new populations are done when possible based on proximity to target sites and availability of resources. In 2011, EPMT staff visited fourteen locations on the outer coast, six of which were known or suspected to have invasive plants present.

Figure 9. Controlling pineapple weed at Pedersen beach.

Prior to 2006 the only invasive plant observations on the outer coast came through various plant surveys conducted in the park (Carlson et al. 2004). Beginning in 2006 the KEFJ EPMT made trips to the monitor and control invasive species in the coastal areas of the park (Kurtz 2010). Invasive plants documented on the outer coast to date include: red top (*Agrostis gigantea*) in Paguna Arm of Two Arm Bay and annual bluegrass at Holgate PUC in Aialik Bay (Carlson et al. 2004); common dandelion near Dinglestadt Glacier in McCarty Fjord (Wetherbee 2006); annual bluegrass at the Aialik PUC (Kurtz 2009); one patch of common timothy grass at the Beauty Bay airstrip, and common plantain and curly dock at Aialik PUC (Kurtz 2010).

In 2011 the KEFJ EPMT conducted two boat trips to control all known infestations on the outer coast with the exception of the red top infestations which were not found in 2010 and possibly no longer exist at that site (Kurtz 2010). A few new sites were surveyed in 2011 in addition to the sites that were re-visited as high potential vector areas. Three KEFJ EPMT crew members took the M/V Naiad to Aialik Bay and stayed at the field camp at Aialik Bay Ranger Station from July

5-8, 2011. The annual bluegrass and curly dock infestations at Aialik Bay PUC were surprisingly large, but the crew was able to control 95-100% of the total infestation. The annual bluegrass infestations at Holgate PUC was also monitored and controlled. In order to decrease the density of these infestations, both PUCs were revisited again on September 8th, all of annual bluegrass regrowth was controlled. Extensive surveying was conducted in the Pedersen area, including Pedersen Beach, the Pedersen Lagoon camping easement, and the recently constructed trail providing access to the upper Pedersen Lagoon from Kenai Fjords Glacier Lodge. Much of this area, including the new trail, are on lands owned by Part Graham Corporation and leased by Alaska Wildland Adventures, but are bordered closely by park managed lands (including the Upper Pedersen Lagoon). Permission was granted by the staff of Kenai Fjords Glacier Lodge to conduct invasive plant surveys across their property. Most of the area mapped was free of weeds with the notable exception of a newly discovered population containing pineapple weed, common plantain, and annual bluegrass near the beach where guests and supplies to the lodge are unloaded, and where their kayaks are stored. This infestation was only partially controlled due to time constraints. Although this location is not on park managed lands, but is rather an in-holding owned by Port Graham Corporation, it should be monitored regularly in cooperation with lodge staff to prevent the spread of these non-native plant species into the park.

In late July a crew of six EPMT members ventured to the outer coast aboard the park's research vessel, the M/V Serac, to conduct control of known invasive plant populations, and to conduct site surveys of new and frequently used areas. A total of ten sites were visited, including three containing target species, and seven surveyed which were free of invasive plants.

A small infestation of common timothy grass at the airstrip in Beauty Bay, which was first documented by KEFJ EPMT in 2007, was controlled manually. The Rosness-Larsen and Waterfield-Goyne mines, whose adits were sealed by park staff in 2010, were surveyed for weeds in 2011. Mine adits, mine camp remnants, and mine access trails were monitoredwith no invasive plants found. The Kinney-mine house and shop, located about one mile north of Palisade lagoon along Babcock Creek, was visited again in 2011 after a plant believed to be non-native self-heal (*Prunella spp.*) was discovered in 2010. After locating the specimen it was decided not to gather any samples of the plant because the phenology was too early (small stems; no flowers) to positively identify it as the non-native variety. An accurate GPS point was taken so that future KEFJ crews working in the area may be able to collect and return a sample. In late August a KEFJ research crew that was in the area collected a plant sample and the specimen was sent to the Alaska Natural Heritage Program (AKNHP) botanists for positive identification.

A small infestation of common dandelions, growing on bedrock hills south of Dinglestadt Glacier, was first discovered in 2006 and has been controlled annually since then (Kurtz 2010). The infestation was revisited and manually controlled again in 2011. A few new patches of dandelions were discovered on the approach hike growing beneath the alders and willows. Another hill, south of the known infestation, was also surveyed for the first time and was found to have a few dandelions in the rocky clearings. This site should remain high priority to future EPMT crews to avoid the spread of common dandelion in this isolated and hard to access area.

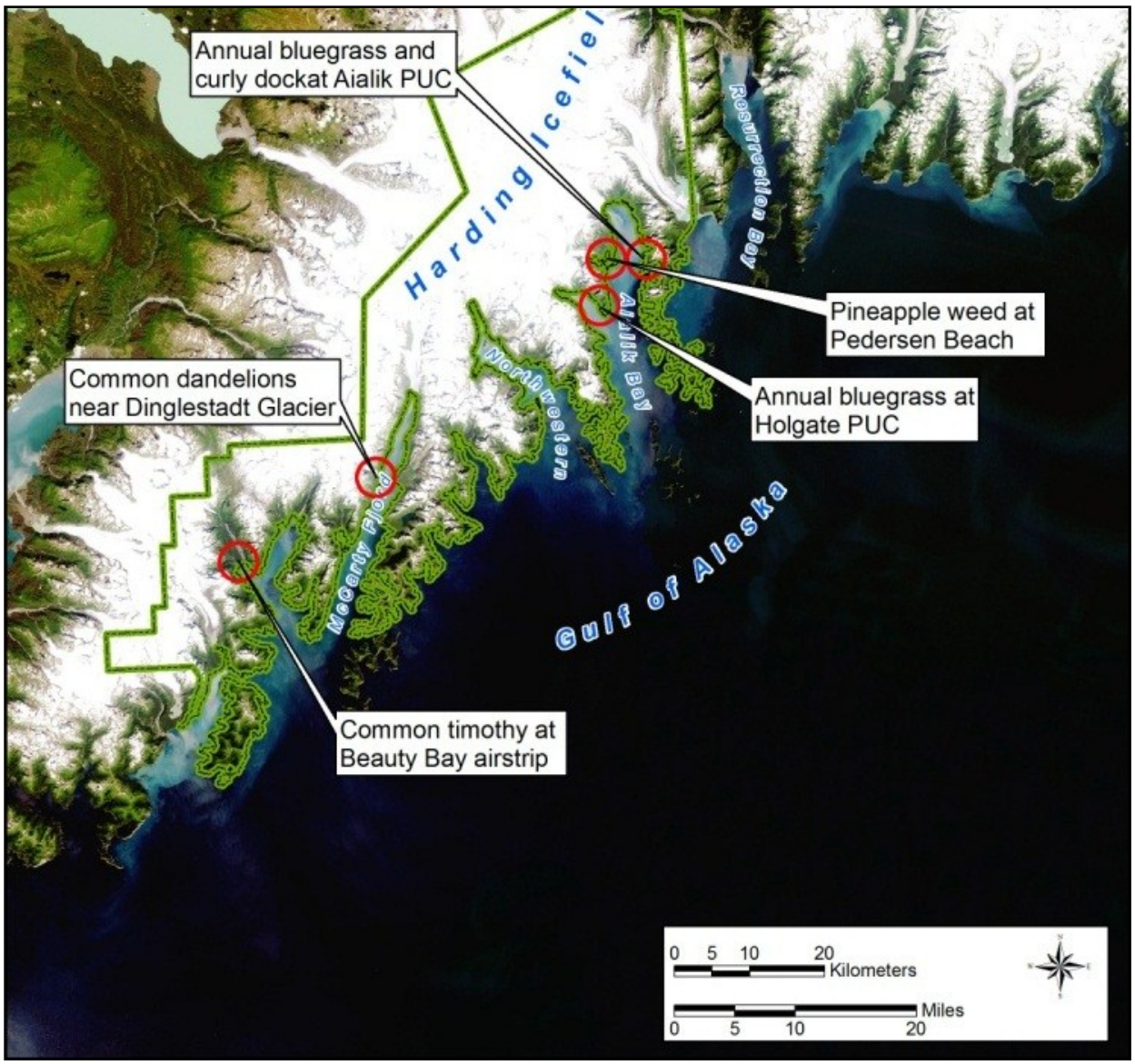

Figure 10. Invasive plant infestations on the KEFJ coast controlled in 2011.

Five other sites were surveyed on the M/V Serac trip including the trail easement to Desire Lake in McCarty Fjord, and four commonly used camping beaches in Northwestern Fjord. All these beaches are on the east shore of Northwestern Fjord, and include the Northwestern Landing beach, Northeastern Glacier campsites, Ribbon Falls beach, and the beach on the northeast side of Harris Bay just beyond the submerged moraine. All these sites were found to be free of non-native plant species.

Community Outreach

Beyond park boundaries other agencies such as the USFS and groups such as the Resurrection Bay Conservation Alliance (RBCA) control invasive plant species along the Exit Glacier roadside for. The KEFJ EPMT staff collaborated with these groups in a Community Weed Pull event held on the June29, 2011. During this event eleven KEFJ staff, eight USFS employees, three members of RBCA, and twenty volunteers from SAGA and the US Navy helped to pull over 600 pounds of invasive plants from Exit Glacier Road. Weed-pull efforts were focused on common dandelion and oxeye daisy control on the east side of Resurrection River Bridge, on white sweetclover reduction on an island in the lower Resurrection River, and on a fall dandelion infestation at the east end of Exit Glacier Road, about one mile from the intersection with the Seward highway. In early August the KEFJ EPMT crew and four SAGA volunteers once again assisted RBCA in their efforts to control fall dandelion from the eastern end of Exit Glacier road and to control yellow alfalfa plants near the Exit Glacier viewpoint.

Figure 11. SCA and SAGA crew members digging up yellow alfalfa.

Figure 12. Informational sign for the boot brush at the Exit Glacier Nature Center.

A new boot brush was installed at the Nature Center in 2011 to provide a way for park visitors to remove seeds from their boots before venturing onto the trail system. It is hoped that this will provide a convenient and educational way for the public to avoid spreading invasive seeds from the parking lot and areas outside the park into pristine areas of the KEFJ backcountry.

2011 marks the first year that KEFJ employed an education intern through SCA focused specifically on invasive plant education. This was a shared position between the Education and Resource Management divisions. The goal for this position was to develop an educational program about invasive plants for youth service groups and to then take service groups out to Exit Glacier to do weed control work. The SCA intern led one service group in mid-June to test the effectivness of the position. The program was successful in giving service proups the educational component they want as well as an experiential work component controlling invasive plants in the park. The SCA Intern also prepared a number of educational materials and developed a ranger-led educational talk to be led by park staff at the Exit Glacier Nature Center.

Discussion

Despite its easy accessibility and proximity to areas heavily infested with non-native species, KEFJ is remarkably free of invasive plants. The park is in a unique position to prevent large scale infestations of invasive plants through early detection and rapid response. Quantities of invasive species, and the numbers and sizes of infestations are much smaller in KEFJ than in many other parks is in Alaska. Throughout the eight year history of the EPMT program at KEFJ the greatest amount of effort has been devoted to the control of common dandelion, the most abundant and widely distributed non-native plant species within the park. Common dandelion has been shown to readily colonize disturbed areas and to rapidly obtain vegetative dominance, sometimes crowding out native seedlings and even invading undisturbed areas (Weaver et al. 1990). In places like KEFJ, where retreating glaciers are continually exposing freshly disturbed land, the control of invasive plants is crucial to maintaining the ecological integrity formed through natural plant succession.

All non-native plant species in Alaska have been assigned an invasiveness ranking by the AKNHP based on their potential ecological impacts, biological characteristics, and distribution (Carlson et al. 2008).

Table 2. Invasive plant species documented within Kenai Fjords National Park.

Taxon	Common Name	Invasiveness Ranking
Linaria vulgaris	yellow toadflax	69
Hordeum jubatum	foxtail barley	63
Leucanthemum vulgare	oxeye daisy	61
Trifolium repens	white clover	59
Taraxacum officinale ssp. *officinale*	common dandelion	58
Trifolium hybridum	alsike clover	57
Phleum pratense	common timothy	56
Crepis tectorum	narrowleaf hawksbeard	54
Ranunculus acris	tall buttercup	54
Trifolium pratense	red clover	53
Poa pratensis	Kentucky bluegrass	52
Rumex acetosella	common sheep sorrel	51
Rumex crispus	curly dock	48
Poa annua	annual bluegrass	46
Plantago major	common plantain	44
Cerastium fontanum	mouse-ear chickweed	36
Matricaria discoidea	pineapple weed	32
Alopecurus pratensis	common foxtail	unranked
Agrostis gigantea	red top	unranked
Brassica rapa	field mustard	unranked
Papaver nudicale	Icelandic poppy	unranked

Species ranking based on the Invasiveness Ranking System for Non-Native Plants of Alaska (Carlson et al. 2008).
Species in **bold** were observed in the park in 2011.
Species in normal font have been observed in the park but were not observed in 2011.

To date there have been 22 documented non-native species found within KEFJ (ten species found in 2011), and at least 16 additional species growing just outside the park (Rapp 2009). Currently the highest ranked invasive plant documented in the park is yellow toadflax which is currently ranked at 69. The yellow toadflax infestation has been reduced by manual treatments performed by KEFJ EPMT staff. The infestation is now a very small area near the boundary of the park along Exit Glacier road. There are a number of aggressive invasive plant species including white sweetclover (ranked 89), bird vetch (73), and oxeye daisy (61) found within a few miles of the park boundary along Exit Glacier road. Other highly invasive species such as reed canarygrass (*Phalaris arundinacea*, 83), orange hawkweed (*Hieracium auranticum*, 79), European Mountain Ash (*Sorbus aucuparia*, 59), common tansy (*Tanacetum vulgare*, 57), and creeping buttercup (*Ranunculus repens*, 54) are found in the nearby town of Seward. These infestations have been observed growing in yards and near state highways where their seeds can be easily transported into new areas. Diligent effort must be continued to keep these invasive plant species from becoming established in the park and compromising the ecological integrity and natural diversity of KEFJ.

Recommendations

Invasive plant management is an ongoing process as every year new invasive plant seeds arrive by natural processes such as wildlife, winds, and floods, and by being inadvertently carried in with park visitors. Every year established infestations persist as invasive plants grow, seed, and spread. It is important that KEFJ maintain the current low levels of infestation through early detection and rapid response to small populations, and continued monitoring and control efforts on larger, more established populations to contain them. Preventative measures, such as the boot brush installation at the Exit Glacier Nature center, are effective ways to educate the public about invasive plants and to reduce seed introduction into more pristine areas of the park. Effectiveness of the boot brush, new to KEFJ in 2011, should be evaluated and current and future placements should be revised based upon this evaluation.

The effectiveness of chemical control in invasive plant management at KEFJ should continue to be studied and considered as a means of treatment. The Exit Creek outwash plain should be revisited to monitor the effectiveness of the herbicide applications, and if the treatment in 2011 is successful, continue treatment of this large, but isolated common dandelion infestation. Alternative methods of control on Exit Glacier road dandelions should also be considered. Alternative digging tools may prove more efficient at treating large numbers of plants than simple hand-digging, while better coordination with park maintenance crews should improve EPMT's ability to conduct chosen control methods at proper stages of plant development.

Efforts at controlling and reducing annual bluegrass infestations within the park should continue to maintain the relatively low abundance of this plant and to avoid the heavy infestations found along trails and in the backcountry of nearby USFS lands. Less abundant species should continue to receive swift and thorough treatment from EPMT staff in order to keep them from becoming large and established populations.

KEFJ EPMT staff should continue to work with volunteer crews, scientists and other park divisions to educate them about the best management practices to avoid the introduction and spread of invasive plants into the park while working here. This includes presentations by EPMT staff to volunteer crews when they first arrive at the park, presenting information to KEFJ staff during their preseason training, and including mitigation measures in scientific research permits to reduce invasive plant introduction.

Non-native plant disposal is an ongoing issue. At KEFJ this is currently done by bagging pulled weeds and disposing of bags at the local dump where they are then removed to an area landfill. Invasive plants are very prolific seeders, with a single dandelion plant able to produce up to 5,000 seeds (Royer and Dickinson 1999). Many species, including dandelion, are able to produce fully viable seeds even after being pulled from the ground or torn into smaller pieces. Until a complete disposal method is devised, one which fully destroys plant material and renders their seed non-viable most controlled plant materials are a potential vector to further spread invasive plants into new areas. Methods that have been tried by other parks, including composting and incineration can be cost or labor prohibitive. Further research should be devoted to this subject and waste-management strategies with partner groups and agencies should be considered.

Activities and programs focused on community outreach should be increased. The Invasive Plant Education SCA Intern that served at KEFJ in 2011 provided a number of outreach services including educational programs for service groups and leading them on weed-pull events in the park, and producing invasive plant informational materials and prizes. This position should continue to be funded, and the park should actively recruit more service groups to participate in this program. Outreach efforts to the local community of Seward should continue to include the distribution of invasive species educational information, and to coordinate invasive plant control events on area roads, parks and trails. Local partner groups, including Alaska Association of Conservation Districts, RBCA, and the Chugach National Forest provide opportunities for KEFJ EPMT to collaborate on projects and events, and as means to share and disseminate information to the general public.

European and Asian Gypsy Moth monitoring should continue to be conducted by KEFJ EPMT staff. With similar vectors of introduction as invasive plants, and their potential harmful effects on native vegetation, the Gypsy Moth project is complementary to EPMT work. With the small amount of time required to establish and monitor these moth traps, park staff will be better assured that this potentially devastating species does not pose an immediate threat to the area.

Literature Cited

Bergelson, J. 1990. Life after death: Site pre-emption by the remains of *Poa annua*. *Ecology* 71(6): 2157-2165.

Bryden, W. 2002. Final report: Exotics inventory for Exit Glacier study area, Kenai Fjords National Park, Summer 2002. National Park Service Unpublished Report, Seward, Alaska.

Carlson, M. L., R. Lipkin, M. Sturdy, and J. A. Michaelson. 2004. Kenai Fjords National Park vascular plant inventory final technical report. Alaska Natural Heritage Program, Anchorage, Alaska.

Carlson, M. L., I. V. Lapina, M. Shephard, J. S. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, and J. Nielsen. 2008. Invasiveness ranking system for non-native plants of Alaska. USDA Forest Service, R10, R10-TP-143.

Hutchinson, C. S. and G. B. Seymour. 1982. Biological flora of the British Isles: *Poa annua* L. *Journal of Ecology* 70(3): 887-901.

Kurtz, D. 2009. Invasive plant management in Kenai Fjords National Park: Summer 2009 field season report. National Park Service Unpublished Report, Seward, Alaska.

Kurtz, D. 2010. Invasive plant management for Kenai Fjords National Park: 2010 Summary report. Natural Resource Data Series NPS/KEFJ/NRDS—2010/109. National Park Service, Fort Collins, Colorado.

Million, B. and W. Rapp. 2011. Alaska Exotic Plant Management Team: 2011 Field protocol. National Park Service Unpublished Report, Anchorage, Alaska.

Rapp, W. 2009. Invasive species summary for the Southwest Alaska Inventory and Monitoring Network. Natural Resource Report NPS/SWAN/NRR—2009/152. National Park Service, Fort Collins, Colorado.

Royer, F., and R. Dickinson. 1999. Weeds of the northern U.S. and Canada. The University of Alberta Press, Edmonton, Alberta.

Weaver, T., J. Lichthart, and D. Gustafson. 1990. Exotic invasion of timberline vegetation, Northern Rocky Mountains. Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High-Mountain Resource. Bozeman, Montana, Department of Agriculture, U.S. Forest Service, Intermountain Research Station, Ogden, Utah, March 1989: 208-213.

Wetherbee, H. 2006. Invasive plant management in Kenai Fjords National Park: Summer 2006 field season report. National Park Service Unpublished Report, Seward, Alaska.

Wetherbee, H. 2007. Invasive plant management in Kenai Fjords National Park: Summer 2007 field season report. National Park Service Unpublished Report, Seward, Alaska.

Appendix A. Cultural Compliance Protocols

The removal of non-native plant species poses a potential threat to the park's cultural resources. The continued presence of non-native plant species, absent removal, also poses a threat to the park's cultural resources. If non-native plants are encountered during the 2011field season in Kenai Fjords National Park, the following protocols are to be employed.

On the Coast:

- Record all non-native specimens found on the coast (document species using EPMT protocol, take photographs of the plant species, as well as the larger surrounding area so the exact location of the plant can be verified in the office).

- Before conducting any removal efforts, attempt to report each non-native plant finding and applicable data to the Cultural Resource Program Manager.
  - A satellite phone should be taken in the field at all times to initiate this consultation.
  - The Cultural Resource Program Manager will determine if the specimen is in an area previously surveyed for archeological resources.

- If the plant is found within one of the following areas, the identified action is allowed without consulting the Cultural Resource Program Manager. Standard EPMT documentation is still required and will be reviewed by the Cultural Resource Program Manager in the end-of-year report.
  - Aialik Public Use Cabin: No potential to affect historic properties. Hand tools may be used in front of cabin and along trail.
  - Bear Glacier: No potential to affect historic properties. Hand tools may be used.
  - Desire Lake easement and trail: No archeological survey completed. Non-native plants may be mapped and harvested above ground only. Contact Cultural Resource Program Manager if further action is needed.
  - Dinglestadt knob: No potential to affect historic properties. Hand tools may be used.
  - Fuel Cache, McCarty Fjord: No potential to affect historic properties. Hand tools may be used.
  - Glacial outwash plain: No potential to affect historic properties. Hand tools may be used.
  - Glass & Heifner airstrip: No potential to affect historic properties. Hand tools may be used.
  - Holgate Public Use Cabin: No potential to affect historic properties. Non-native grasses with surface and shallow root systems (<2") may be skimmed off the surface using trowels. Contact Cultural Resource Program Manager if further action is needed.
  - James Lagoon: No archeological survey completed. Non-native plants may be mapped and harvested above ground only. Contact Cultural Resource Program Manager if further action is needed.
  - Kinney Mine Site: Collection of specimen for identification purposes only. Contact Cultural Resource Program Manager if further action is needed.
  - Pedersen Lagoon: No potential to affect historic properties. Hand tools may be used.

- Quartz Bay Camping Easement: Archeological site has been recorded in area. Non-native plants may be mapped and harvested above ground only. Contact Cultural Resource Program Manager if further action is needed.
- Rosness Larson Mine Site: Eligible for National Register. Non-native plants to be harvested above surface only.
- Taroka Arm: No potential to affect historic properties. Hand tools may be used in camping area.
- Waterfield/Goyne Mine Site: No potential to affect historic properties. Hand tools may be used.

- If the site has not been surveyed or is in an area where archeological sites are known to be present, and the Cultural Resource Program Manager is unavailable for consultation, do not disturb the soil or objects on the ground. All above-ground non-native plant materials may be removed using scissors or knife, including flowers and seed pods.

At Exit Glacier:

- If the site is within the area covered by the Exit Glacier Area Plan and General Management Plan Amendment, soil disturbance is permitted and the plant may be removed using hand tools. There is no need to report this data beyond standard EPMT protocols.

Definitions:

- Ground disturbance - includes any activity which mechanically moves soil, rocks, or other materials; such as pulling plant root materials from the soil, moving rocks, using trowels or shovels, or inserting items into the soil.

Contacts:

Cultural Resource Program Manager, Shannon Kovac 907-422-0541 (office), shannon_kovac@nps.gov

Chief of Resource Management, Fritz Klasner, 907-422-0546 (office), 907-491-0799 (cell), fritz_klasner@nps.gov

Appendix B. 2011 Gypsy Moth Monitoring at Exit Glacier

Author: Deb Kurtz

Introduction

This year the Alaska NPS units, coordinated by the Alaska Exotic Plant Management Team Liaison, helped the Alaska Division of Agriculture conduct forest moth surveys by monitoring for the European gypsy moth (*Lymantria dispar*) and the Asian gypsy moth (*L. japonica*). Gypsy moths were introduced from Europe to Massachusetts in 1869 for possible silk production and are now well-established in the eastern US with small populations in the western US (PA DCNR, 2011). Gypsy moths pose a serious threat to the forested ecosystems of Alaska. Large populations of gypsy moth larvae can completely defoliate a hardwood tree; repeated defoliation can result in tree mortality.

Figure B-1. European Gypsy Moths: female (top) and male (bottom).

Increased commercial activity and tourism as well as climate warming trends increase the probability that non-native organisms that are introduced into Alaska will establish breeding populations and begin to spread (USDA 2011). Monitoring is imperative to detect an invasive species early and to be able to implement a cost-effective rapid response control measure. During the years that the forest moth surveys have been conducted, a few European gypsy moths have been captured, but it is believed that this species has not established itself in Alaska (C. Knight, personal communication, 6 April 2011).

Figure B-2. Moth trap located on the south side of the parking lot at Exit Glacier.

Methods

2011 was the first year that Kenai Fjords National Park (KEFJ) monitored for gypsy moths. Monitoring consisted of setting five traps near potential pathways of introduction i.e., recreation areas and campgrounds. The moths are typically transported to new areas on human related items (lawn furniture, RVs, ships, cars, containers, camping equipment that has been in storage, etc.) and can arrive during any portion of their life cycle. Current monitoring efforts target the adult flying male moths. The traps were set to coincide with the moths' flight period which, in their native range, is generally between mid- June / mid July to late August / mid- September. Historically, the captures in Alaska have occurred between late July and late August.

Five traps were hung around the parking lot at Exit Glacier and the parking lot at the park campground from mid-June through mid-September. The traps were made of a waxed cardboard

and had a string stapled to the inside that was coated with female gypsy moth pheromones that acts as an attractant to the males. In theory, if any male European gypsy moths are in the area, they would be attracted to the pheromones and would enter the trap in search of the female gypsy moth producing this pheromone. Once they enter the trap they would get stuck in a sticky coating that lines the inside of the trap. The traps were checked every two weeks and data was entered into a GPS for efficient data management.

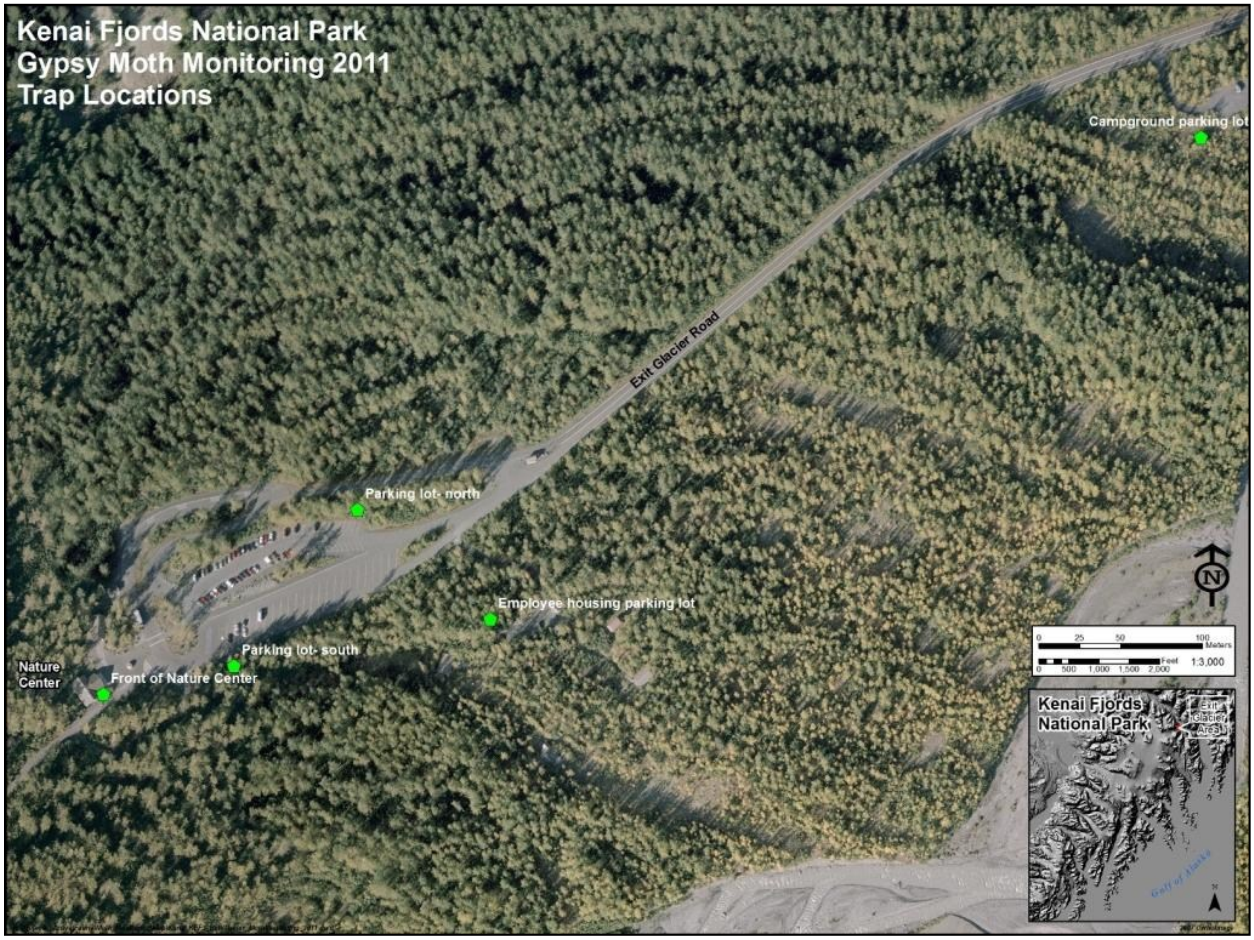

Figure B-3. Five traps were set in the Exit Glacier area of Kenai Fjords National Park to monitor for gypsy moth species.

Results

Traps were monitored five times during the summer between mid-June and mid September. Although some moths were captured, they were identified as geometrid moths, not gypsy moths. No gypsy moths were observed in the traps during the 2011 field season. Dozens of flies and some bees were captured and died during the study.

Conclusions and Recommendation

No gypsy moths were observed in the Exit Glacier area during the 2011 field season. KEFJ staff should continue to monitor for this nonnative species as part of an early detection and rapid response effort. The monitoring effort is simple, requires little time, is non-intrusive, and provides park managers with additional information to effectively manage the park.

References

PA DCNR. 2011. Gypsy Moths. http://www.dcnr.state.pa.us/forestry/gypsymoth/index.aspx. Pennsylvania Department of Conservation and Natural Resources. Accessed 2011-09-30.

USDA. 2011. Invasive Interceptions: Gypsy moth and invasive moth detection in Alaska. Issue Paper June 2011. US Department of Agriculture, Forest Service, Alaska Region.